



## 5bv.3.21 PV led engine

PV led engine characterization lab for standalone light to light systems

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# 5BV.3.21 PV LED ENGINE

## CHARACTERIZATION LAB FOR STAND-ALONE LIGHT TO LIGHT SYSTEMS

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### Abstract

PV-powered lighting systems, light to light systems (L2L), offer outdoor lighting where it is elsewhere cumbersome to enable lighting. Application of these systems at high latitudes, where the difference in day length between summer and winter is large and the solar energy is less requires smart dimming functions for reliable lighting. In this work we have build a laboratory to characterize these systems up to 200 WP from “nose to tail” in great detail to support improvement of the systems and to make accurate field performance predictions.

### Background

Light to light systems are typically solar powered stand alone lamps using a LED as light source. Park lights and bollards are examples of L2L systems and these systems offers lighting solutions, for places where lighting is not feasible due to very high cabling costs of e.g. 700 € /m in Copenhagen. At low latitudes dimensioning of such products is relatively easy, since there is plenty of sun and the difference between day length between summer and winter is small. However in locations further away from equator, the difference in day length between summer and winter increases, and the solar potential is less. Therefore construction of reliable lighting with feasible dimensions requires intelligent harvesting and efficient usage of energy becomes crucial. Since high power MPPT-charge regulators are not subjected to any standards e.g. not all charge regulators comply with the manufactures specification, and within this work low maximum power point tracking (MPPT)-efficiencies of commercially available regulators are measured, and therefore this work emphasize the importance of full system testing. In this work we build a laboratory where we can measure all the parts of such light to light systems, and use the data for optimization of products and accurate prediction of field performance.

### LIGHT-2-LIGHT characterization laboratory

The lab basically enables the following:

- Optical transmission measurement on the optional front optics (angle dependent, and spectrally resolved)
- IV characterization from below 50 W/m<sup>2</sup> to 1000 W/m<sup>2</sup> of the solar panels
- Electronic efficiency measurement for the charge circuit and the LED driver, where emulators emulate the measured PV output and the measured battery and LED behavior. The power is measured externally with a power analyzer.
- Standby power quantification
- Optical characterization of the LED where the luminous flux and the light distribution will be measured spectrally resolved.
- Characterization of the LED casing, enabling prediction of the lighting profile and the photometric data.

Below is shown an example of IV characterizati-

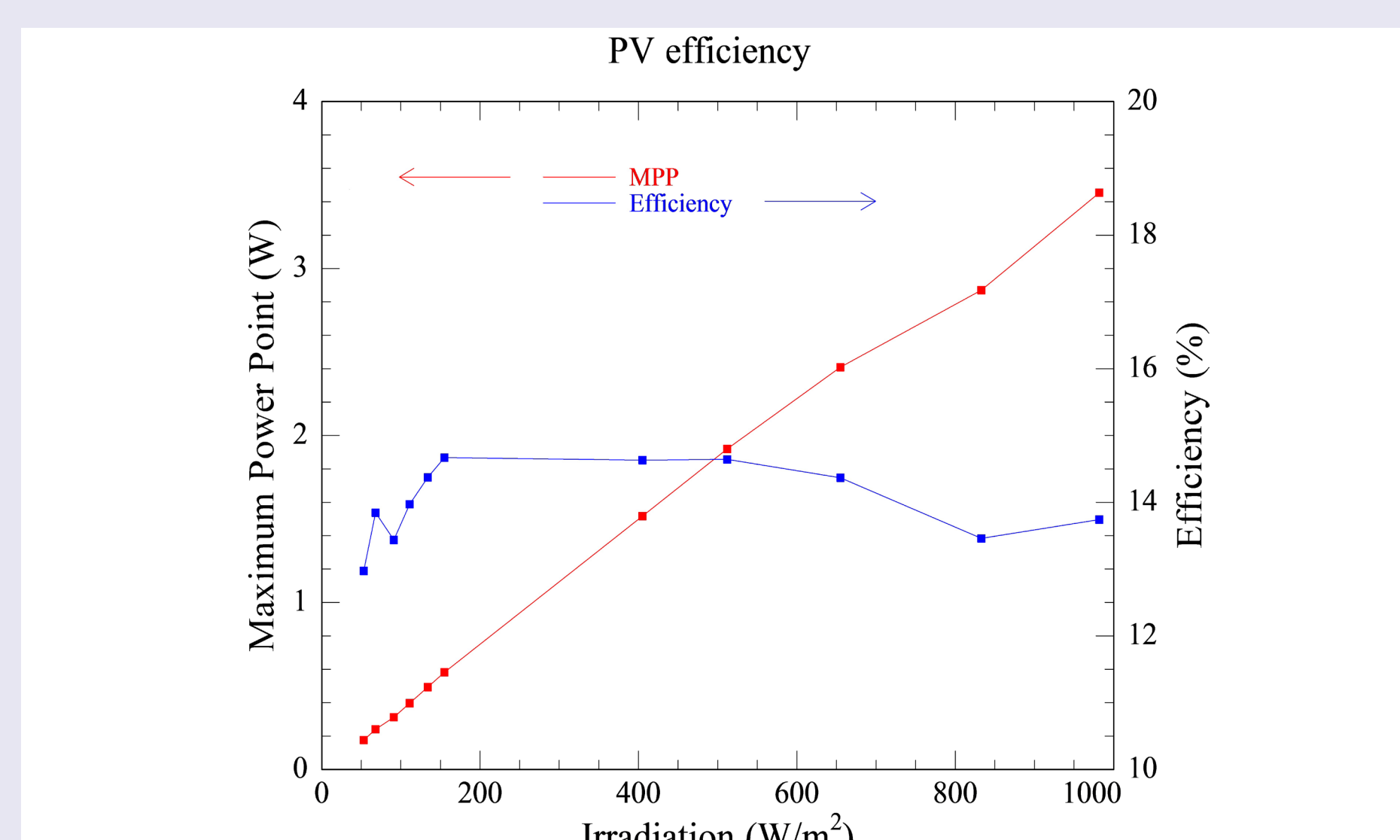


Figure 1. Measurement on the solar panel at different illumination levels. An IV-curve is recorded for each measurement point.

### Example of efficiency of charger

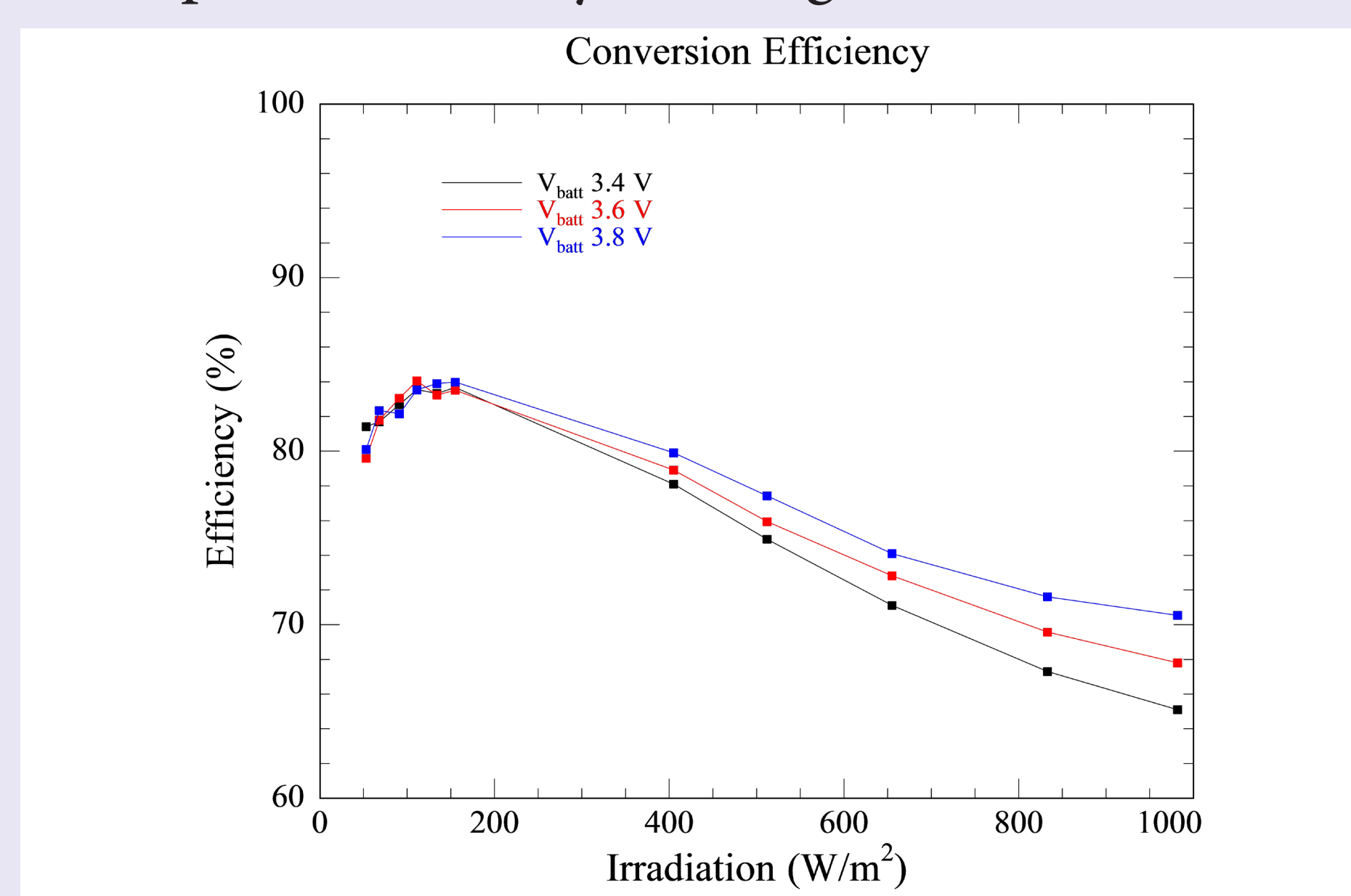


Figure 2. The conversion efficiency of the charger. This chargers seems to be optimize for low power.

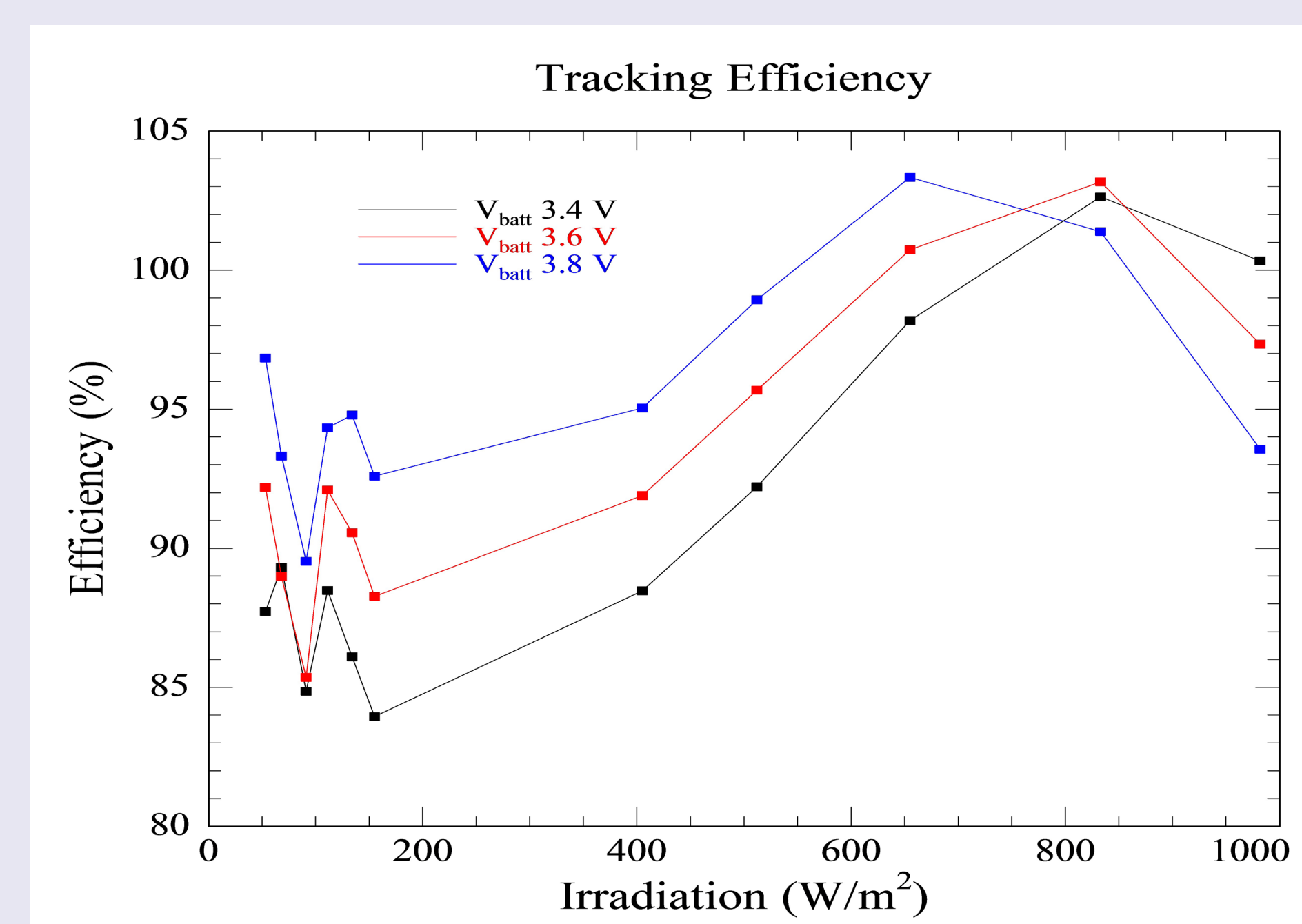


Figure 3. The powerpoint tracking efficiency as a function of irradiation. The efficiencies above 100 %, is explained by the accuracy of the emulator, in this case an Agilent E436x SAS system.

### Conclusion

These preliminary measurements provide a deep insight in the losses and the behavior of these smaller light to light systems. Further the preliminary measurements indicate that the electronic controller in the L2L systems has the highest potential for improvement. Future work includes implementing the shown laboratory measurement in the PV LED engine software, and use these data for accurate field prediction.

### Aknowledgements

The project is funded by the Danish Energy Technology Development and Demonstration Programme, project number 64011-0323, “The PV LED Engine - new generation of intelligent solar powered LED lighting”.

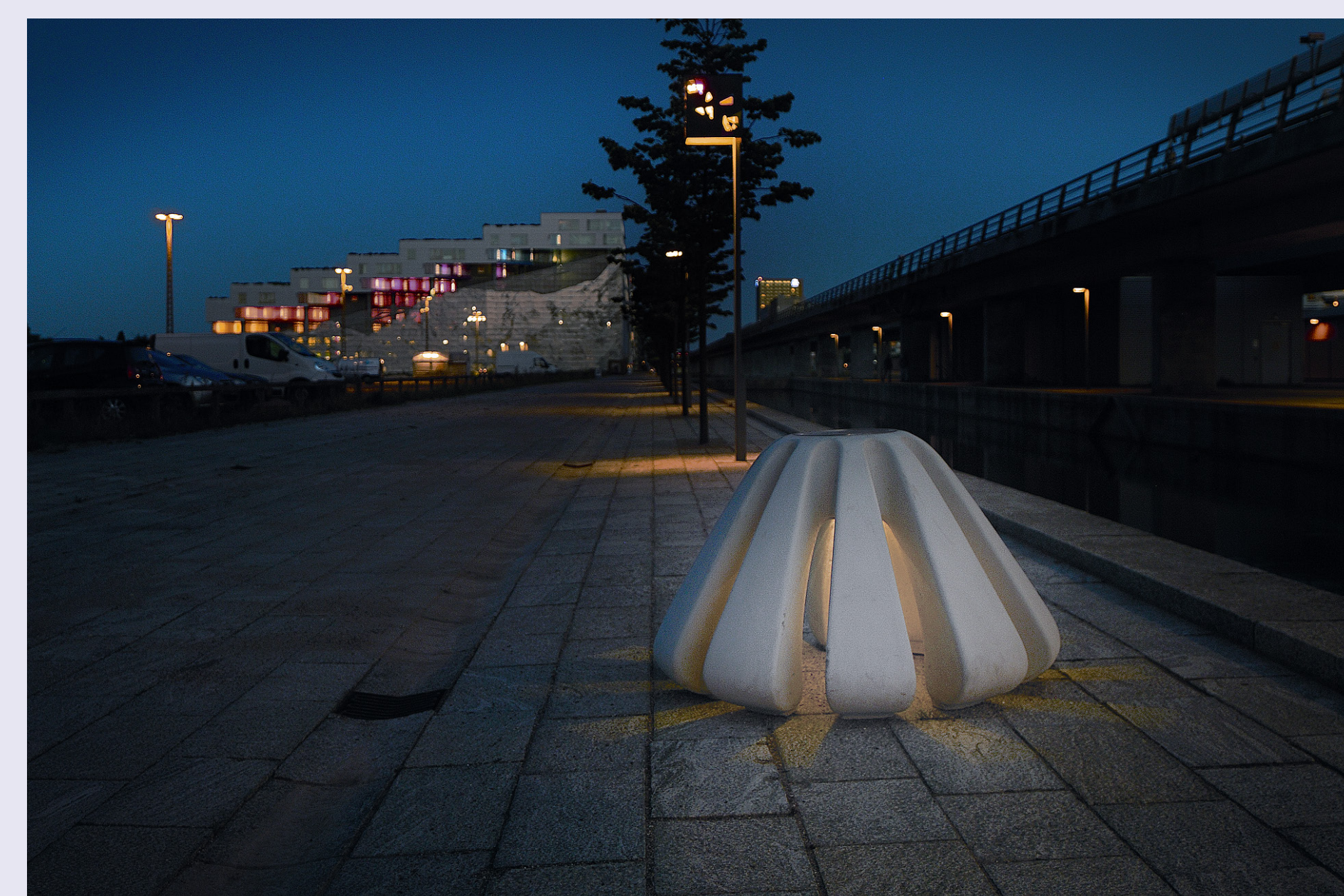


Figure 4. Jello, a PV LED Engine driven product installed in Copenhagen. The product has been characterized from nose to tail in the LIGHT-2-LIGHT laboratory to enhance its performance.